Citation:

Berg C, Lappas G, Wolk A, Strandhagen E, Torén K, Rosengren A, Thelle D, Lissner L Eating patterns and portion size associated with obesity in a Swedish population. *Appetite*. 2009 Feb;52(1):21-6.

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Study Design:

Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

The aim of this study was to investigate the association between habitual eating patterns and obesity.

Inclusion Criteria:

- Individuals participating in INTERGENE, a population based research program assessing the interplay between genetic susceptibility and environmental factors for the risk of chronic diseases in western Sweden
- The survey started in April 2001 and continued until August 2004
- The study population consists of randomly selected women and men aged 25-74 (at time of sampling), living in Vastra Gotaland Region.

Exclusion Criteria:

Pregnant women

Description of Study Protocol:

Recruitment: For the INTERGENE study, a letter of invitation was mailed out 2 weeks prior to the clinical appointment. The study population consists of randomly selected women and men living in the Vastra Gotaland Region. All subjects gave their written informed consent.

Design: Cohort Study

Blinding used: N/A

Intervention: N/A

Statistical Analysis:

- *t*-test - used to test the differences between obese and non-obese men and women in intake of energy, fat, carbohydrates and protein
- Logistic regression models and Hosmer and Lemeshow test of model adequacy - used to adjust for age, sex, physical activity level, smoking, education (university education or not) and employment status (in work or not) and to test sex interactions

Data Collection Summary:

Timing of Measurements:

- BMI was calculated and height and weight were obtained after 4 hours of fasting
- Food frequencies, meal patterns, physical activity, smoking, education and employment status were assessed by a self-administered questionnaire
- Participants were also asked how often they usually consumed cooked meals and meals outside the home. Habitual portion sizes for a traditional hot meal were estimated by means of hour colored pictures corresponding to nine categories
- Physical activity during leisure time was categorized into four levels with a validated questionnaire that has been used in Goteborg since the 1960s.

Dependent Variables

- Obesity: BMI (kg/m^2)

Independent Variables

- Energy intake: self-administered food frequency questionnaire
- Habitual eating patterns: Yes/No response to question about eigh possible typical Swedish meals (coffee, breakfast, between meal snack, lunch, between meal snack, dinner, supper, night meal)
- Habitual portion size

Control Variables

- Physical activity: validated questionnaire; classified into 4 levels

Description of Actual Data Sample:

Initial N: 3610 participants (1908 women and 1702 men)

Attrition (final N): 3594 participants (1892 women and 1702 men)

Age: 25-74 years of age (at the time for sampling)

Ethnicity: Swedish

Other relevant demographics:N/A

Anthropometrics: The prevalence of obesity was 14.5% in women and 15.4% in men

Location: The Vastra Gotaland Region in western Sweden

Summary of Results:

Key Findings:

- Being obese was significantly associated with omitting breakfast, omitting lunch and eating at night
- Obesity was also related to larger self-reported portion-sizes, with 13% increased risk of being obese for each increment in portion size among nine possible sizes. Adjusting for education and employment did not change this association
- The estimated intake of energy was lower than reference values for "healthy" range of BMI and sedentary lifestyle, indicating under-reporting.

Meal patterns by BMI group

	BMI<25	25≤BMI<30	≥30	*p* for trend
Women, *n* (%)	987±52	629±33	275±15	
Men, *n* (%)	591±35	847±50	262±15	
No breakfast (%)				
Women	7.9	9.4	10.2	NS
Men	9.8	11.0	17.6	0.003
No lunch (%)				
Women	16.9	20.2	24.4	0.004
Men	20.0	20.8	28.1	0.02
Night meal (%)				
Women	2.8	4.6	6.6	0.003
Men	6.5	5.3	8.1	NS
Cooked meal <2/day (%)				
Women	70.2	66.2	70.9	NS
Men	64.9	68.1	69.2	NS
Meals away (%)				
Women	71.6	63.2	51.1	<0.0001
Men	78.5	72.1	74.1	NS

Crude and adjusted odds ratio for obesity by meal patterns

	Crude odds ratio (95% CI)	Adj. for age & sex odds ratio (95% CI)	Multivariate adjusted odds ratio (95% CI)

Breakfast Yes (*n*=3215) No (*n*=363)	1 1.54(1.17, 2.02)	1 1.44(1.09,1.90)	1 1.41(1.05,1.90)
Lunch Yes (*n*=2850) No (*n*=726)	1 1.49(1.20,1.84)	1 1.24(1.00,1.55)	1 1.31(1.04,1.66)
Night meal No (*n*=3396) Yes (*n*=180)	1 1.63(1.13,2.35)	1 1.68(1.16,2.44)	1 1.62(1.10,2.39)
Cooked meal ≥2/day Yes (*n*=1139) No (*n*=2436)	1 1.12(0.91,1.36)	1 1.07(0.87,1.13)	1 1.07(0.87,1.32)
Meals away No (*n*=1060) Yes (*n*=2475)	1 0.66(0.55,0.80)	1 0.91(0.73,1.13)	1 0.88(0.70,1.10)
No of meals per day (1-8)	0.97(0.90,1.06)	0.99(0.91,1.07)	0.97(0.89,1.06)
Portion size (1-9)	1.03(0.98,1.09)	1.11(1.04,1.18)	1.13(1.05,1.21)

Mean (S.D.) daily intake based on food frequency questionnaire in non-obese and obese

	Non-obese absolute intake	Non-obese relative intake	Obese absolute intake	Obese relative intake
Women	(*n*=1545)		(*n*=268)	
Energy (MJ)	7.4±2.2		7.2±2.3	
Fat (g,E%)	62±25	31.3±5.9	59±26	30.7±5.8
Carbohydrates (g,E%)	215±68	48.8±6.6	214±73	50.0±6.8
Mono- and disaccharides (g,E%)	90±39	20.2±6.1	95±46	21.8±6.7
Protein (g,E%)	76±26	17.2±2.5	74±25	17.3±2.9

Alcohol (g,E%)	6±5	2.3±2.2	4±4	1.5±1.8
Fiber (g,g/MJ)	22±9	3±0.9	21±8	3±0.9
Men	(*n*=1367)		(*n*=252)	
Energy (MJ)	11.2±3.4		10.7±4.0	
Fat (g,E%)	92±35	30.9±5.3	88±40	30.8±5.2
Carbohydrates (g,E%)	329±110	49.3±6.3	314±127	49.2±6.3
Mono- and disaccharides (g,E%)	117±57	17.5±5.9	119±71	18.2±6.4
Protein (g,E%)	107±35	16.2±2.2	106±42	16.8±2.5
Alcohol (g,E%)	12±10	3.3±2.9	10±8	2.9±2.6
Fiber (g,g/MJ)	30±13	2.7±0.8	28±13	2.7±0.8

Author Conclusion:

- The present study supports the hypothesis that meal patterns are associated with obesity. The results indicate that obese individuals have a meal pattern with consumption later in the day compared to non-obese
- Obese subjects reported larger meals and as many intake occasions as non-obese subjects even though breakfast and lunch were often omitted, indicating that more and larger meals were consumed during the second half of the day
- Obese men and women reported significantly larger portions than non-obese, which may lead to a higher energy intake and over-consumption
- Sweden has a tradition of lunch at restaurants or at the work place which might be better form an energy point of view than replacing lunch with energy-dense snacks and sweets. This might explain why the present study does not support the notion that an increased consumption of meals eaten away from home contributes to the obesity epidemic. On the contrary, obese women were less likely to eat meals outside home than other women
- In the present study, the association between eating away from home and obesity disappeared when the model was adjusted for being employed indicating that obese women eating fewer meals outside home might be unemployed, retired or students
- The results were consistent with the suggestion that the habitual consumption of morning and lunch meals is important for maintaining energy balance in Swedish adults
- It can be inferred that underestimation of energy intake seems to be greater in the obese group
- Interestingly, a simple question about portion sizes showed a clear association with obesity, suggesting that dietary questionnaires could be improved by adding questions about meal patterns and portion sizes.

Reviewer Comments:

- *A self-report of habitual meal patterns will probably not capture irregular eating and snacking. Thus, underreporting of snack intake is likely to occur with this king of questionnaire, and might be associated with obesity*

- *A weakness of this study is the low response rate, but it is not likely that these associations are the result of a selection bias . Possibly, obese individuals might be less likely to take part in the study*
- *Another limitation is that the available data cannot clarify the causal factors underlying diet patterns and obesity.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A

3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	???
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes

6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	N/A
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A

8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes